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Original scientific paper

Carabelli's Trait in Contemporary Slovenes and Inhabitants of a Medieval Settlement (Središče by the Drava River)

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A B S T R A C T

The objectives of this study were to determine the total frequency, expression and asymmetry of Carabelli's trait in permanent dentitions of contemporary Slovenes and a medieval skeletal population from northeastern Slovenia. A total of 254 dental casts from contemporary Slovene children were examined. The population of a medieval settlement (10^{th} – 15^{th} centuries), was represented by 94 skeletons. A modification of the method of Alvesalo and associates was used to classify Carabelli's trait on a five-grade scale. The trait was expressed on the upper first molars of 79.7% of the contemporary subjects and 75.8% of the medieval sample. Positive expressions of the trait were found in 10.1% of the contemporary subjects and 15.2% of the medieval sample. While the observed total frequency of the trait in both samples is characteristic of Europeans, the rates of positive expressions are surprisingly low but consistent with data from a recently published worldwide literature survey. Both populations showed a low rate of left-right fluctuating asymmetry of the trait. This finding might reflect a pronounced ability of individuals in the medieval population to buffer unfavourable influences from the environment and a relatively low level of environmental stress in the contemporary population.

Key words: *Carabelli's trait, dental morphology, morphological asymmetry, Middle Ages, contemporary Slovenes*

Introduction

Teeth are an excellent object for the study of human variation and are used to address questions in numerous disciplines including anthropology[1]. Morphological features of teeth are controlled to a greater extent by genes than are skeletal features[2]. In contrast to bone, hard dental tissues do not remodel once they have formed. Consequently, tooth morphology changes through life only as a result of pathological (e.g. caries, resorption, trauma) and age-dependent processes (e.g. wear). Teeth are very resistant to post-mortem degradation and to mechanical trauma; so they are generally better preserved than bones in archaeologically derived human remains. An additional advantage of teeth is that their morphological features are observable on extracted specimens, on specimens from skeletal-dental remains, on dental impressions or cast reproductions, and directly in the mouth of a living person.

Carabelli's trait occurs on the palatal surface of the mesiopalatal cusp (protocone) of permanent upper molars and deciduous upper second molars. It is a quasi-continuous variable, i.e. it can be either present or absent, but when present, it exhibits continuous variation in expression[3]. The expression of the trait varies from a slight or distinct single furrow, pit, double furrow, y-shaped furrow, or slight protuberance lacking a free apex, to a small, moderate or large cusp, which occasionally equals in size the main occlusal cusp. A pit and a furrow (single, double, y-shaped) are negative expressions of the trait, whereas a protuberance and a cusp are its positive expressions[4].

Recent studies support a polygenic mode of inheritance[5]. The genetic factors underlying the expression of Carabelli's trait are best represented by the upper first molar, which is therefore used as a key tooth for population comparisons[6]. It was formerly assumed that Carabelli's trait clearly discriminates among major human groups[7], but it is now known that its pattern of geographic variation is not so distinct[6,8]. Besides having an

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anthropological and forensic value, Carabelli's trait plays an important role in phylogenetic and ontogenetic studies of dental development[9]. Some authors believe that this trait is increasing in frequency through evolution[10–12], while others hold that it is in the process of reduction[13–15]. A negative expression (pit or furrow) and a groove between Carabelli's cusp and the mesiopalatal cusp have clinical implications since they represent a predilection site for dental caries.

Carabelli's trait has not been analyzed in contemporary and former inhabitants on Slovene territory so far. The objective of this study was to compare the frequency, expression and left-right asymmetry of Carabelli's trait in permanent dentition of a contemporary Slovene population and a medieval skeletal population (10^{th} – 15^{th} centuries) from northeastern Slovenia. We assumed that medieval and contemporary populations from the study area are historically and genetically related and will thus have a similar frequency and expression of the trait.

Material and Methods

Contemporary population

Observations were made on 254 dental casts of the maxillary dental arch from contemporary Slovene children and adolescents aged 6 to 15 years (148 females, 106 males). The dental casts were collected at the Orthodontic Unit, University Medical Centre Ljubljana, Slovenia. A total of 620 permanent upper molars (501 first, 119 second) were examined. It was possible to score both upper first molars in 233 casts (91.7%) and both upper second molars in 56 casts (22.0%). Only permanent teeth were utilized, due to the small number of primary second upper molars present in medieval material.

Medieval skeletal population (Središče by the Drava river)

This research is part of a broader anthropological analysis performed by the Department of Biology, Biotechnical Faculty in Ljubljana, Slovenia. The skeletal-dental material represents part of a rural parish cemetery dated to the 10^{th} – 15^{th} centuries. It was excavated at Središče by the Drava river in northeastern Slovenia during the years 1993–94. Biological characteristics of the skeletal material, including age and sex structure, were established according to standard procedures[16]. All maxillary arches with at least one preserved permanent molar were included in the study. A total of 200 permanent upper molars (111 first and 89 second) from 94 skeletons (22 male, 40 female and 32 unspecified) were examined. Tooth type was determined according to position in the dental arch and standard morphological criteria[17]. In many cases, extensive occlusal wear, dental caries and post-mortem damage impeded the observation of Carabelli's trait. Consequently, the data for upper first molars came from a total of 33 skeletons, and those for upper second molars from a total of 36 skeletons. A total of 56 upper first molars and 57 upper second molars could be scored for the trait. We were able to score the trait on both (left and right) upper first molars in 23 (24.5%) skeletons and on both upper second molars in 21 (22.3%) skeletons.

Trait classification

Although most researchers classify Carabelli's trait into eight categories as proposed by Dahlberg[32], we employed a method with less categories, not so much because of the small size of the medieval sample but mainly in order to realiably classify the trait on worn molars. The teeth were observed under good lighting using a 10-power hand lens. A slight modification of the method of Alvesalo and associates[4] was used to classify the trait on a five-grade scale, ranging from absence through four grades of presence. In our classification, a y-shaped furrow was combined with a pit and a single furrow into grade 1. So expression was scored as follows: grade 0 – smooth surface (trait absent); grade 1 – pit, single furrow, y-shaped furrow (Figure 1a-c); grade 2 – double furrow (Figure 1d and e); grade 3 – slight protuberance, small cusp (Figure 1f and g); grade 4 – large cusp (the distal border of the cusp is in contact with the palatal groove separating the mesiopalatal and distopalatal cusps) (Figure 1h and i). Grades 1 and 2 represent negative expressions of the trait, while grades 3 and 4 are its positive expressions.

Counting method

In both study populations, Carabelli's trait was scored on both sides of the upper dental arch. For statistical analysis of the frequency and expression of the trait, we followed the unilateral count method[8]. According to this method, observations made on the right side were used for analysis. If this was not possible (missing teeth, extensive wear, post-mortem damage, poor quality of dental cast), observations made on the left side were employed.

Intra-observer reliability

All observations were made by first author on two separate occasions. Agreement in scoring the presence (grades 1–4) or absence (grade 0) of the trait was 89.2%. A discrepancy of any magnitude between two scores was present in 12.5%, and of more than one grade in 5.0% of double observations. The difference between the mean scores of the two scoring sessions, estimated by the paired sample *t*-test, was not statistically significant.

Statistical analysis

Association for the occurrence and expression of the trait between first and second molars and between the two populations was assessed using the χ^2 test. Correlation in the expression of the trait between right and left teeth was evaluated by Pearson's correlation coefficient. Statistical significance of correlation was assessed using the chi-square test.

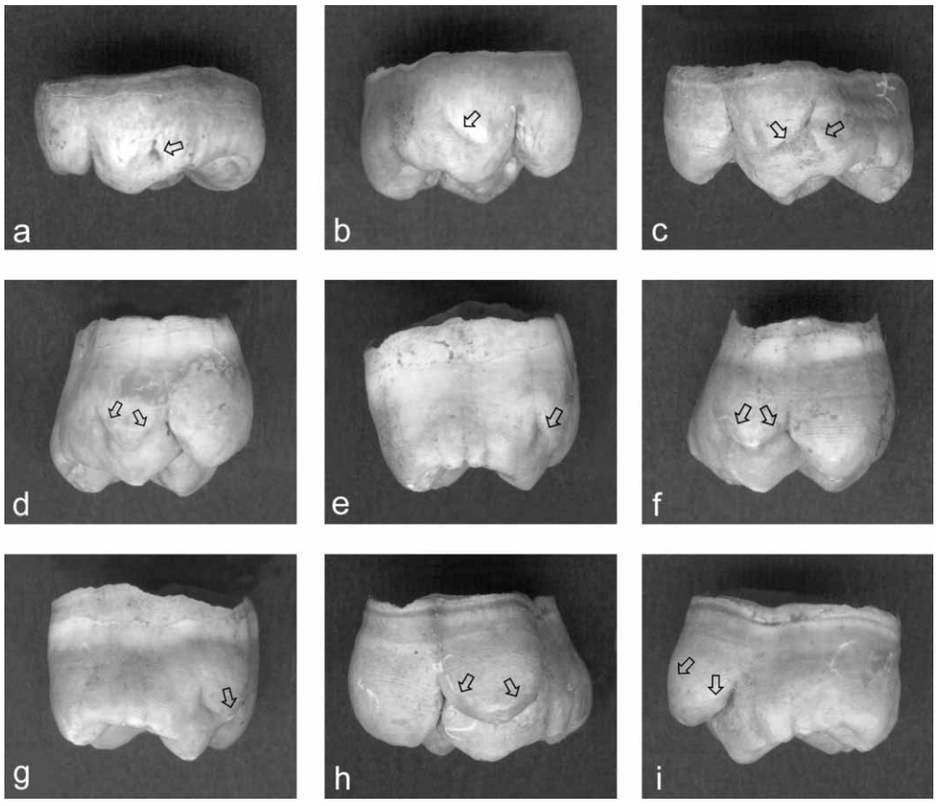

Fig. 1. Expressions of Carabelli's trait on permanent upper molars from a medieval sample (Središče by the Drava river). a) pit (grade 1), b) single furrow (grade 1), c) y-shaped furrow (grade 1), d) double furrow (grade 2), e) mesial aspect of the molar in d, f) slight protuberance (grade 3), g) mesial aspect of the molar in f, h) large cusp (grade 4), i) mesial aspect of the molar in h. Magnified x4. Arrows in sections e and g show absence of a free apex.

All computations were carried out with the SYSTAT 5.0 statistical package for Microsoft Windows.

Results

Frequency and expression of Carabelli's trait in the contemporary population

The total frequency of Carabelli's trait, as determined by the unilateral count method, was 79.7% for the first and 14.9% for the second upper molars (Table 1); the difference was statistically significant (χ^2_1=83.1, p<0.001). On the first molar, the trait was expressed as a positive structure (slight protuberance or cusp) in 10.1% of individuals, and as a negative structure (pit, single, double or y-shaped furrow) in 69.6% of individuals (Figure 2). The trait was most frequently expressed as a double furrow (35.6% of individuals), and as a pit, single or y-shaped furrow (34.0% of individuals). A slight protuberance or small cusp was present in 9.3%, and a large cusp in 0.8% of individuals.

On the second molar, the most frequent form of the trait was a pit or a single or y- shaped furrow (7.4% of individuals). A double furrow was present in 5.6% of individuals, and a slight protuberance or small cusp in 1.9% of individuals. The trait was never present in the form of a large cusp. Differences in the expression of the trait between the first and the second molar could not be evaluated statistically due to the small number of second molars displaying the trait.

Left-right asymmetry of Carabelli's trait in the contemporary population

Table 2 presents trait expression on the right and left first molar of the same individuals. Correlation in expression of the trait between the two first molars was very strong (r=0.998) and statistically significant (χ^2_9= 339.1, p<0.001). Cases with bilateral absence of the trait were not considered symmetrical. Therefore, 34 individuals with bilateral absence of the trait were excluded from the asymmetry calculations. In this way, we eliminated the effect of total trait frequency on the estimates of asymmetry[18]. 146 individuals (73.4%) showed identical expression of the trait on both first molars. In 16 individuals (8.0%), the trait was expressed on one first molar but absent on its contralateral (presence-absence asymmetry). The total frequency for any degree of asymmetry

TABLE 1
EXPRESSION OF CARABELLI'S TRAIT ON PERMANENT FIRST AND SECOND MOLARS IN CONTEMPORARY SLOVENES AND INHABITANTS OF A MEDIEVAL SETTLEMENT (SREDIŠČE BY THE DRAVA RIVER)

Upper molar	Population	Grade of expression									
		0			1		2		3		4	
		n_1	n_2	%	n_2	%	n_2	%	n_2	%	n_2	%
1st	Contemp.	247	50	20.2	84	34.0	88	35.6	23	9.3	2	0.8
	Medieval	33	8	24.2	17	51.5	3	9.1	2	6.1	3	9.1
2nd	Contemp.	54	46	85.2	4	7.4	3	5.6	1	1.9	0	0.0
	Medieval	36	34	94.4	2	5.6	0	0.0	0	0.0	0	0.0

n_1 – number of individuals, n_2 – number of individuals with/without Carabelli's trait, 0 – trait absent, 1 – pit, single furrow, y-shaped furrow, 2 – double furrow, 3 – slight protuberance, small cusp, 4 – large cusp

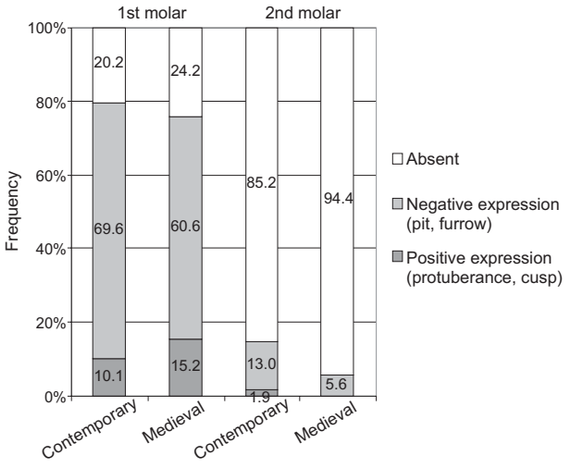

Fig. 2. Expression of Carabelli's trait on permanent upper first and second molars in contemporary Slovenes and inhabitants of a medieval settlement Središče.

was 26.6%. In 14 individuals the trait was expressed as a positive structure on one first molar and as a negative structure on its contralateral.

Asymmetries in the occurrence and expression of Carabelli's trait on the left and right second molars were present in 88.7% and 50% of subjects, respectively.

None of the subjects showed absence of the trait on one first or second molar and a protuberance or cusp on its contralateral. All cases of asymmetry were less pronounced, conforming to one of the following patterns: absence of the trait on one molar and a negative structure on its contralateral, or a negative structure on one molar and a positive structure on its contralateral.

Frequency and expression of Carabelli's trait in the medieval population

The total frequency of Carabelli's trait was 75.8% for the first and 5.6% for the second upper molars (Table 1); the difference was statistically significant ($\chi^2_1=32.7$, $p<0.001$). On the first molar, the trait was expressed as a positive structure (slight protuberance, cusp) in 15.2% of individuals and as a negative structure (pit, single, double or y-shaped furrow) in 60.6% of individuals (Figure 2). A pit, single or y-shaped furrow was found in 51.5% of individuals, a double furrow in 9.1%, a slight protuberance or small cusp in 6.1%, and a large cusp in 9.1% of individuals.

Only two individuals displayed the trait on their second molars. In one of them it was expressed as a pit and in the other as a single furrow. A more detailed analysis of differences in expression between the first and second molars was not possible due to the small number of second molars displaying the trait.

Left-right asymmetry of Carabelli's trait in the medieval population

Table 2 presents trait expression on the right and left first molars of the same individuals. The correlation between the two sides was very strong ($r=0.904$) and statistically significant ($\chi^2_9=43.5$, $p<0.001$). Five individuals with bilateral absence of the trait were excluded from the asymmetry calculations. Fourteen (77.8%) individuals showed identical expression of the trait on both first molars. In two individuals out of 18 (11.1%), the trait was expressed only on one side (presence-absence asymmetry), in both cases as a negative structure. In two individuals, it was present bilaterally but with a different degree of expression. So the total frequency for any degree of asymmetry was 22.2%. A single rank difference between the two upper first molars was established in one individual, and a difference of two grades also in one. Considering all asymmetrical cases, a difference of a single rank between antimeres was found in three individuals (16.7%), and a rank differential of two grades in one individual (5.6%). In one individual, the trait was expressed as a positive structure on one first molar and as a negative structure on its contralateral. The trait was never absent on one molar and expressed as a protuberance or cusp on its contralateral.

Evaluation of second molars showed bilateral absence of the trait in 19 individuals. In two subjects, the trait was expressed on the left second molar (in one as a pit

TABLE 2
ASYMMETRY IN THE EXPRESSION OF CARABELLI'S TRAIT ON PERMANENT UPPER FIRST MOLARS IN CONTEMPORARY SLOVENES AND INHABITANTS OF A MEDIEVAL SETTLEMENT SREDIŠČE

Contemporary Slovenes						
		Left side				
	Grade	0	1	2	3+4	Total
		Number of individuals				
Right side	0	34*	5	1	0	40
	1	8	57*	13	2	80
	2	2	10	71*	4	87
	3+4	0	2	6	18*	26
	Total	44	74	91	24	233

$r=0.998$ ($\chi^2_9= 339.1$, $p<0.001$)

Medieval sample						
		Left side				
	Grade	0	1	2	3+4	Total
		Number of individuals				
Right side	0	5*	1	0	0	6
	1	1	8*	1	1	11
	2	0	0	2*	0	2
	3+4	0	0	0	4*	4
	Total	6	9	3	5	23

$r=0.904$ ($\chi^2_9=43.5$, $p<0.001$)

*Individuals with bilateral absence or symmetrical expression of Carabelli's trait.

and in the other as a single furrow) and absent on its contralateral. The percentage of asymmetry was not calculated due to the small number of teeth displaying the trait.

Comparison of the contemporary and medieval populations

The total frequency of Carabelli's trait on the first molar was 79.7% in the contemporary population and 75.8% in the medieval sample; the difference was not statistically significant (Table 1). The total frequency of the trait on the second molar was higher in the contemporary population (14.9%) than in the medieval sample (5.6%); statistical significance was not evaluated due to the small number of second molars displaying the trait.

The frequency of positive expressions of the trait (protuberance and cusp) on the first molar was 15.2% in the medieval sample and 10.1% in the contemporary population; the difference was not statistically significant (Figure 2). The populations differed considerably in the frequency of large cusps (contemporary population 0.8%, medieval sample 9.1%), although statistical significance could not be evaluated due to the small number of individuals.

The frequency of presence-absence asymmetry for the first molar was similar in both populations, amounting to 8.0% in the contemporary population and 11.1% in the medieval sample (Table 2). The total frequency for any degree of asymmetry was 26.6% in the contemporary and 22.2% in the medieval population; the difference was not statistically significant. Correlation in expression of the trait between left and right first molars was very strong and statistically highly significant in both populations ($r>0.9$, $p<0.001$).

Discussion

The medieval skeletal sample available for this study was relatively small, which is a characteristic problem of samples from small ethnic areas, such as Slovenia. On the other hand, the trait was observed in a ranked fashion with adequate intra-observer reliability[8,17,18]. Therefore, in spite of sampling limitations, we believe that our study provides comparable, accurate results that can be utilized in further interpopulation comparisons.

Total frequency of Carabelli's trait

Because of the small number of individuals in the medieval sample, we combined the data for both sexes. Most previous studies revealed no evidence of sexual dimorphism in the expression of this tooth crown trait[4,5,8,13,17,21–28]. A study of Noss et al. (1983)[29] showed evidence of slight dimorphism, which would be difficult to detect in small samples.

The total frequency of Carabelli's trait on the first molar, a key tooth for population comparisons, was 79.7% in contemporary Slovenes and 75.8% in inhabitants of the medieval settlement Središče. These values agree with the data published for other Western Eurasian populations. Most authors who studied the trait on dental casts or archaeologically derived teeth reported total trait frequencies between 70 and 90%[4,8,20,26–28,30–36]. Authors who examined living individuals reported frequencies lower than 60%[10,37–43]. The difference is most probably related to difficulties in scoring low-grade expressions in living individuals[8], especially if the examination was carried out under field conditions.

For the second molar, the total trait frequency was 14.9% for the contemporary population and 5.6% for the medieval population. The difference is probably related to the small size of the medieval sample. Reported total trait frequencies for other Western Eurasian populations range between 3 and 43%[20,32,33,40,44]. Brabant and Twiesselmann (1964)[45] reported frequencies between 0.5 and 25% for European samples from different historical periods. A significant difference in total trait frequency between first and second molars established in this study is consistent with Butler's field model[46] and Osborn's clone model[47] for the development of teeth.

Expression of Carabelli's trait

Both populations exhibited similar frequencies of negative and positive forms of the trait. On the first molar, it was expressed as a positive structure in 15.2% of individuals in the medieval sample and in 10.1% of individuals in the contemporary population. The frequency of positive forms is supposed to be more reliable for comparison with published data than total trait frequency[6]. The latter has a limited value due to variable treatment of negative expressions by different observers. Most authors who studied Carabelli's trait in Western Eurasian populations reported frequencies between 20 and 55% for positive forms[4,8,12,20,26–28,32,36,40,42,44,48–50]. Lower rates, similar to those observed in our study, were reported for a French megalithic population (Manthelan) (10.9%)[51], a medieval Belgian population (Coxyde) (12%)[52] and Finnish Lapps (15.9%)[17]. Asian and Asian-derived populations generally have low frequencies of positive forms: Chinese 10.4%[53], Japanese 9.9%[54], Peruvian Indians 12.4%[55], Paraguayan Indians 10.8%[56] and Canadian Inuit 9.1–17.6%[57]. Scott and Turner[6] cite frequencies of 20–30% as characteristic of Western Eurasians, 10– 15% as typical of Eastern Asians, and 0–10% as typical of North Asians, Eskimo-Aleuts and American Indians. On the contrary, Turner and Hawkey[58] report that the average frequency of positive forms in Europeans is rather low (12%) and comparable to the rates observed in Southeast Asians (12%), Africans (11%) and North American Indians (9%), whereas appreciably higher rates are found among Near/Middle Eastern (33%), Micronesian (23%), Polynesian (17%) and even North Asian (16%) peoples. Our findings agree with those of Turner and Hawkey[58]. Since our geographical area was never exposed to strong migration pressures from the east, the observed low rates of positive expressions of the trait cannot be regarded as a Mongoloid ethnic feature of the populations under investigation.

The frequency distribution of individual grades of expression of the trait in our subjects showed considerable differences between the two populations. Grade 1 was the modal category in the medieval population and grade 2 in the contemporary population. Both grade 1 and grade 2 represent negative expressions of the trait. There was a major difference in the frequency of large cusps between the contemporary population (0.8%) and the medieval sample (9.1%). These differences may be due to the small size of the medieval sample, but they may also reflect actual intergroup variation. Further studies, ideally, on skeletal samples from the same geographical area and period, would be necessary to resolve this question. Nevertheless, the similarities in total frequency of the trait and frequency of its negative and positive forms between the two populations suggest that the medieval inhabitants of Središče represent predecessors of contemporary Slovenes. This conclusion is supported by the observation of Scott and Turner[6] that recent skeletal samples and modern populations from the same area (assuming genetic propinquity) show similar frequencies of morphological traits.

Left-right asymmetry of Carabelli´s trait

Left-right morphological asymmetry is usually fluctuating (random or non-directional) and less often systematic (directional)[59]. The former is characterized by random distribution of differences between sides, and the latter by consistently greater development of the trait on one side than on the other. Animal experiments, twin studies and comparisons among populations indicate that fluctuating asymmetry is caused by environmental influences which disturb tooth development ('developmental noise') and is not directly genetically determined[60–62]. On the other hand, the ability of an individual (and population) to buffer environmental disturbances during development depends on varying genotypic combinations (indirect genetic influence)[63,64].

In contemporary Slovenes and medieval inhabitants of Središče, Carabelli's trait on the upper first molar tended to display a symmetrical expression, with very few individuals (only 3 of 256) displaying expressions categorized as grade 2 on one side of the mouth and no evidence of the trait on the other. This confirms the assumption that common genetic factors are likely to control dental traits on both sides of the dental arch[6].

Published data about asymmetry of Carabelli's trait are rather variable, which to some degree probably reflects methodological differences. Different authors report frequencies between 0 and 16% for presence-absence asymmetry (0–14% with the bilateral absence category included), and between 7 and 51% for total asymmetry (8–45% with the bilateral absence category included)[4,8,20,24,26–28,30,33,65–67]. Thus the results of this study place both studied populations near the middle of the alleged frequencies of asymmetry. We found a presence- absence asymmetry rate of 8% (6.9% with the bilateral absence category included) in the contemporary population and 11.1% (8.7%) in the medieval population. These rates increased to 26.6% (22.7%) in the contemporary population and to 22.2% (17.4%) in the medieval sample when all forms of asymmetry were considered.

In the contemporary population, a difference of a single rank between antimeres was found in three individuals (16.7%), and a rank differential of two grades in one individual (5.6%). Only two individuals in the medieval sample showed an asymmetry in the degree of expression, amounting to a difference of a single grade in one and two grades in the other. Similar observations were made in a study on ten world samples by Scott (1980)[8].

Studies have also shown that the amount of morphological asymmetry generally increases from mesial to distal along the morphological field[20,33,68]. In this study, after removal of the bilateral absence category, the second molar was more asymmetrical than the first molar. Greater asymmetry in teeth of a class that develop later points to a causal relationship between environmental influences and fluctuating asymmetry[20].

Authors who have studied human populations found a relationship between the amount of dental asymmetry and unfavorable living conditions (childhood infections,

episodes of fever, protein and vitamin deficiency, etc.)[60,69]. The medieval population of Središče was characterized by a short lifespan (half of adults died before the age of 40 years) and a high rate of child mortality (children form 29% of the skeletal collection, but they are probably underrepresented)[70]. Demographic data thus suggest that nutritional inadequacy and infectious diseases were common in the medieval population. The upper first molar may start to develop before the fifth fetal month[71], but the mineralization of its crown is completed only between two and a half and three years of age[72]. Therefore its development is influenced by prenatal and postnatal environmental factors. Demographic data for the contemporary Slovene population indicate favorable living conditions and a high standard of medical care: in the year 2003, infant mortality was 4.0 per 1000 live births, and average age at death was 68.2 years for men and 77.2 for women[73]. Although the medieval population was most probably exposed to higher levels of environmental stress, a similar degree of morphological asymmetry was found in both samples. This may be explained by a greater ability of individuals in the medieval population to buffer developmental disturbances. In the harsh living conditions prevalent in those times, only healthy infants resistant to external noxious influences were born and managed to survive beyond early childhood.

Conclusions

This study showed that three quarters of individuals in both the contemporary population and the medieval sample expressed Carabelli's trait on their upper first molars. A high total trait frequency is characteristic of Western Eurasian populations. In both samples, positive expressions of the trait (protuberance, cusp) were much less common than in most other European populations reported in the literature. The total frequency and expression of the trait were similar in both samples, suggesting a close genetic propinquity of the two populations. The low rate of fluctuating asymmetry of the trait observed in both samples may indicate that individuals in the medieval population had a pronounced ability to buffer unfavorable influences from the environment, while the contemporary population was exposed to comparatively low levels of stress during the period of development.

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CARABELLIJEVO SVOJSTVO KOD SUVREMENOG STANOVNIŠTVA SLOVENIJE I STANOVNIŠTVA SREDNJOVJEKOVNOG NASELJA (SREDIŠČE NA DRAVI)

S A Ž E T A K

Cilj ovog istraživanja bio je odrediti ukupnu frekvenciju pojave, izražaj i asimetriju Carabellijevog svojstva u trajnoj denticiji kod današnjih Slovenaca i kod srednjovjekovnih skeleta iz sjeveroistočne Slovenije. Ispitano je ukupno 254 zubnih modela današnje slovenske djece. Populaciju srednjovjekovnog naselja (10.–15. stoljeće) reprezentirali su 94 skeleta. Za klasifikaciju Carabellijevog svojstva korištena je modifikacija metode Alvesala i suradnika sa skalom od pet stupnjeva. Ovo svojstvo bilo je prisutno na prvim gornjim kutnjacima sa 79,7% kod današnjeg stanovništva i sa 75,8% u srednjovjekovnom uzorku. Pozitivni izražaj svojstva (Carabellijeva kvržica) bio je zastupljen sa 10,1% kod današnjeg stanovništva i sa 15,2% u srednjovjekovnom uzorku. Dok je ukupna frekvencija svojstva u obje skupine karakteristična za Europljane, udio pozitivno izraženog svojstva je začuđujuće nizak, ali u skladu s nedavno objavljenim pregledom svjetske literature. Obje populacije pokazale su nisku stopu fluktuirajuće asimetrije lijevo-desno, što bi moglo upućivati na izraženu sposobnost srednjovjekovnog stanovništva da ublaži nepovoljne utjecaje okoliša i na relativno niske razine okolišnog stresa kod suvremene populacije.